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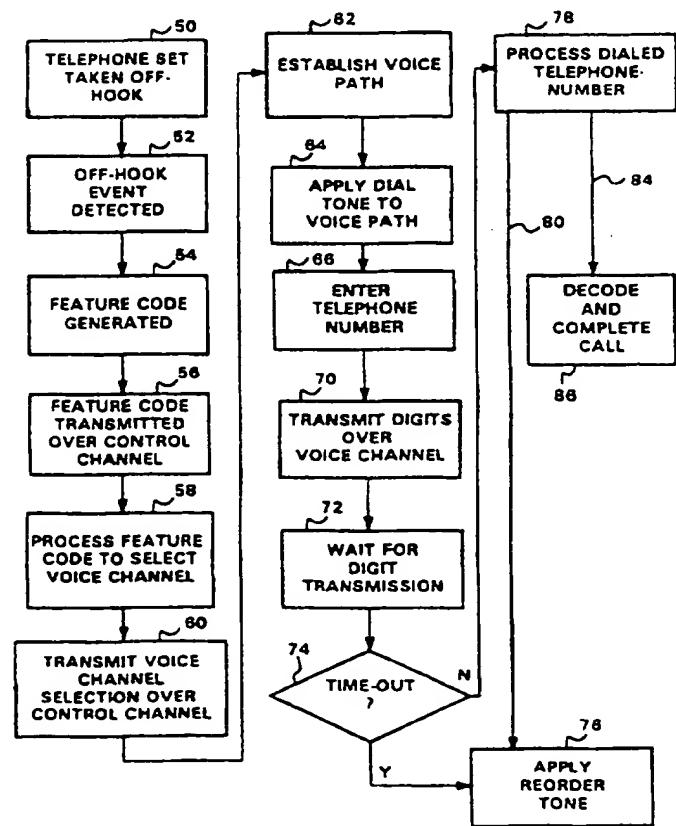
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(54) Title: METHOD AND APPARATUS FOR PROVIDING AN IMPROVED CALLER INTERFACE IN A FIXED CELLULAR COMMUNICATIONS SYSTEM

### (57) Abstract

In a fixed cellular telephone system (10), an improved caller interface is provided wherein the taking of a standard wireline telephone set (12) off-hook (50) triggers the establishment of a voice path (62) between the telephone set (12) and the cellular system switch (16). A dial tone is then applied (64) by the cellular system to the voice path and a caller enters (66) the digits of the telephone number of the party to which the call is directed. The caller dialed digits are transmitted over the voice path (70) to the cellular system switch (16) where they are processed (78) to complete the call connection to the called party. The dialed digits are further analyzed on a one-by-one basis to determine whether improper or unauthorized digits or combinations of digits have been entered by the caller. The caller interface provided by the fixed cellular system (10) of the present invention accordingly operates in a substantially identical manner to that experienced with a conventional wire-based telephone system and in an improved manner over that provided in a conventional cellular system.



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METHOD AND APPARATUS FOR PROVIDING  
AN IMPROVED CALLER INTERFACE IN A  
FIXED CELLULAR COMMUNICATIONS SYSTEM

5       BACKGROUND OF THE INVENTION

Technical Field of the Invention

The present invention relates to cellular telephone systems and, in particular, to a fixed cellular communications system.

10      Description of Related Art

Most people who already have telephone service take their telephone service for granted. They do not realize that in many locations telephone service is a limited resource, and that service providers are often hard pressed to offer that service to all who desire it. Wire-based telephone service providers simply cannot keep up with the recent surge in demand for telephone service. While a large portion of this demand can be traced to the increased use of facsimile machines (which each may require a separate telephone number), an equally significant source of demand can be traced to the increased numbers of people who now want and can afford telephone service. Many times, the increases in population and accompanying increases in demand for telephone service occur in areas where the existing wire-based telephone system infrastructure is either inadequate to handle the increased demand or is completely nonexistent. In such cases, people must wait for the service provider to take the steps needed to establish the required telephone system and catch-up with the demand. Waits as long as several months for a new telephone

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number, and several years for the installation of wire-based telephone systems having adequate capacity, are not uncommon in heavily populated cities or remote locations.

5       The planning costs involved in expanding existing or initiating new wire-based telephone systems are enormous when you consider the need for both the acquisition of rights of way and the renovation or construction of the service providing infrastructure (comprising, for example, the switching networks and the laying or stringing of telephone cable).     However, before making these expenditures, wire-based telephone service providers must know (or be able to accurately project) exactly where their customers will be located, how many customers will be there, and when they are going to arrive and need the service. It is often the case that service providers act in a reactionary rather and proactive manner with respect to subscriber demand, and are accordingly not prepared to meet the increases in demand in a timely fashion. This failure is caused primarily by the significant time delay 10      experienced from the point of approving the provision of a wire-based telephone system and its actual installation and placement into operation. These delays have caused 15      telephone service providers to re-think the use of conventional wire-based telephone systems when addressing pending needs for telephone service initiation or 20      expansion.

25       Cellular telephone systems provide an attractive alternative to conventional wire-based telephone systems, especially in connection with the provision of new or expanded telephone service in heavily populated or remote areas where significant increases in demand are or have 30

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been encountered. The expense, aggravation and time involved in acquiring rights of way and establishing the infrastructure to provide telephone service are obviated or substantially reduced with the installation and use of  
5 a cellular telephone system. However, the cost to the subscriber on a monthly or per call basis often drastically exceeds the cost for similar activities incurred with respect to wire-based telephone systems. Furthermore, the mobility advantage of cellular telephone  
10 systems, which is accounted for in the increased subscriber cost of the service, is often a feature that many telephone service users do not want to pay for or necessarily need.

Accordingly, efforts have been made to couple  
15 cellular systems with conventional analog telephones and provide a hybrid telephone system wherein telephone sets are fixed at certain locations as in a wire-based system but instead access the telephone network using radio frequency communications in a cellular environment. Such  
20 systems, conventionally referred to as fixed cellular systems, interface a conventional analog telephone set, like that used in wire-based telephone systems, with a radio frequency transceiver, like that used in a mobile telephone, operating within a cellular telephone system.  
25 The primary advantages of fixed cellular systems are the elimination of the costs and hassles of acquiring rights of way and laying or stringing telephone cables, and the ease and swiftness with which the system may be installed and made operational. The availability of a fixed  
30 cellular system thus offers service providers a tool for

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quickly reacting to increases in demand at a reasonable provider and subscriber expense.

In spite of the fact that the subscriber's communication device (telephone set) looks like a conventional analog wire-based telephone set, in a fixed cellular system the telephone set unfortunately operates like a cellular mobile telephone, and thus suffers from the known caller interface disadvantages and inconveniences experienced with cellular service. For example, when a call is to be initiated in a fixed cellular system, the phone number must be first completely dialed into in the telephone set through the keypad and then sent to the cellular system for processing. No instantaneous feedback is provided to the caller during the dialing operation concerning the propriety of the entered numbers. The transmission of the dialed number over the cellular network is made only after the activation by the caller of a send button on the keypad. The caller must then wait while the cellular network side of the system selects the voice channel to carry the conversation and completes the call to the called party. The fixed cellular system caller interface accordingly and undesirably operates more slowly relative to, and in a manner completely foreign to the manner of operation experienced in, a conventional wire-based telephone system.

Efforts have been made to have the fixed cellular system mimic operation of the wire-based telephone system with respect to some aspects of the caller interface. For example, it is known to include functionality for simulating at the cellular system interface the dial tone

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and reorder tones heard on conventional wire-based systems before and during the caller dialing operation. Also, functionality has been provided in fixed cellular systems for automatically generating the send command at the 5 cellular system interface following completion of caller entry of a telephone number. With these features, the analog telephone set connected to a fixed cellular system operates more like a conventional wire-based telephone set than a cellular mobile station. However, improvements in 10 this caller interface are still needed with respect to the speed with which the connection to the called party is established. Furthermore, there would be an advantage if the caller interface also functioned to monitor the propriety of the caller dialed numbers during the dialing 15 operation.

#### SUMMARY OF THE INVENTION

A fixed cellular network in accordance with the present invention includes a conventional standard 20 telephone set interfaced with a cellular telephone network through a fixed cellular terminal over a radio frequency air interface. The cellular telephone network includes a mobile switching center and at least one base station operating in radio frequency communication with the fixed 25 cellular terminal. When the standard telephone set is taken off-hook by the caller to initiate a call, this event is detected by the fixed cellular terminal and a signal indicative of the off-hook condition is sent to the mobile switching center over a signaling channel of the 30 cellular radio frequency air interface. Responsive to the receipt of the off-hook signal, the mobile switching

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center selects a voice channel of the radio frequency air interface to carry the call and a voice path including the selected voice channel is established between the mobile switching center and the standard telephone set via the fixed cellular terminal. A dial tone is then applied to the voice path, and in response thereto the caller enters the digits of the telephone number for the party to be called. The dialed digits of the telephone number are transmitted one-by-one over the voice channel to the mobile switching center for analysis in completing the call connection to the dialed party. One-by-one analysis of the dialed digits of the telephone number is further made to determine whether improper or unauthorized digits or combinations of digits have been entered by the caller or excessive time delays during digit entry have been experienced. The caller interface in the fixed cellular system accordingly operates in a substantially identical manner to that experienced with a conventional wire-based telephone system.

20

#### BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the method and apparatus of the present invention may be obtained by reference to the following Detailed Description when taken in conjunction with the accompanying Drawings wherein:

FIGURE 1 is a block diagram of a fixed cellular telephone system;

FIGURE 2 is a flow diagram illustrating a method of operation for the fixed cellular telephone system of the present invention during call set-up;

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FIGURE 3 is a ping-pong diagram illustrating the actions taken by, signals transmitted between, and connections made between the components of the fixed cellular system in accordance with the method of FIGURE 5 2;

FIGURE 4 is a flow diagram illustrating an alternative method of operation for the fixed cellular telephone system of the present invention; and

FIGURE 5 is a ping-pong diagram illustrating the actions taken by, signals transmitted between, and connections made between the components of the fixed cellular system in accordance with the method of FIGURE 4.

#### DETAILED DESCRIPTION OF THE DRAWINGS

Reference is now made to FIGURE 1 wherein there is shown a block diagram of a fixed cellular telephone system 10 in accordance with the present invention wherein a standard telephone set 12 of the DTMF tone dial variety is connected for operation to a cellular telephone network 14. The cellular telephone network 14 comprises a mobile switching center (MSC) 16 connected by communications links 18 to a plurality of base stations (BS) 20. The connection between the standard telephone set 12 and the cellular telephone network 14 is made through a fixed cellular terminal 24 operating to establish radio frequency communications links with a proximately located base station 20'.

The radio frequency communications links established between the base stations 20 and any cellular mobile stations 22, and between the base station 20' and the fixed cellular terminal 24 are effectuated over an air

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interface 26 comprising at least one control channel (CC) 28 and a plurality of voice channels (VC) 30 per base station. The control channels 28 comprise bi-directional communications channels for carrying command and control signals between the base stations 20 and the mobile stations 22, and between the base station 20' and the fixed cellular terminal 24. The voice channels 30, on the other hand, comprise bi-directional communications channels for carrying voice communications between the base stations 20 and the mobile stations 22, and between the base station 20' and the fixed cellular terminal 24. Any type of cellular network air interface 26 that provides for both control and voice channels 28 and 30, respectively, may be utilized by the cellular telephone network 14, including those air interfaces specified for use in the well known AMPS, D-AMPS and GSM cellular telephone systems. The control channels or voice channels in the air interface 26 may therefore comprise either or both a certain radio frequency carrier in an analog cellular telephone system and/or a certain time slot provided within a carrier in a digital cellular telephone system, and the fixed cellular terminal may operate in either or both an analog or digital mode, respectively.

The fixed cellular terminal 24 operates as an interface between one or more standard telephone sets 12 and the cellular network 14. When operable as a multi-line terminal, the fixed cellular terminal 24 functions like a private branch exchange (PBX) to allow a plurality of subscriber telephone sets at one general location (for example, a business or a small town) to be provided with fixed cellular telephone service. As a single-line

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terminal. On the other hand, the fixed cellular terminal 24 provides a connection for a single subscriber telephone set at one given location (for example, a house). The fixed cellular terminal 24 may accordingly comprise either 5 the Single-line or Multi-line Terminal manufactured by Ericsson for the CMS 8800 AMPS/D-AMPS Fixed Cellular telephone system configured in accordance with the present invention to provide an improved caller interface as will be described.

10. The fixed cellular terminal 24 comprises a radio unit (RU) 32, a line interface unit (LIU) 34 and a control unit (CU) 36. The radio unit 32 provides all the radio frequency communications functionality typically found in a mobile station 22 for a cellular telephone system. 15. Thus, the radio unit 32 includes a tunable radio frequency transceiver device for accessing the radio frequency carriers (and the digital cellular system TDMA or CDMA time slots therein if applicable) for the control channels 28 and voice channels 30 provided within the air interface 20. The line interface unit 34 provides the functionality for interfacing the one or more connected standard telephone sets 12 to the radio unit 32. The control unit 36 manages the operation of the radio unit 32 and the line interface unit 34 to provide the signal conversions 25 required to establish and terminate calls to and from the line interface unit 34 through the cellular network 14. The control unit 36 further manages all the necessary information required for establishing and authenticating calls over the cellular network 14.

30. Reference is now also made to FIGURE 2 wherein there is shown a flow diagram illustrating a method of operation

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for the fixed cellular telephone system 10 of the present invention to provide an improved caller interface during call set-up. At step 50, one of the standard telephone sets 12 is taken off-hook by a caller to initiate a call. 5 This off-hook event is detected by the line interface unit 34 of the fixed cellular terminal 24 in step 52. Responsive to the detection of the off-hook event, in step 54 the fixed cellular terminal 24 generates a special feature code indicative of the off-hook condition of the 10 telephone set 12. The generated feature code is then transmitted in step 56 to the mobile switching center 16 over the air interface 26 using one of the control channels 28.

At the mobile switching center 16, the received 15 feature code is processed by a channel selection unit 38 and a voice channel 30 of the air interface 26 is selected in step 58 to carry the call. A signal identifying the selected voice channel 30 is then transmitted in step 60 back over the control channel 28 of the air interface 26 20 for delivery to the fixed cellular terminal 24. Responsive thereto, a connection is made by the fixed cellular terminal 24 in step 62 between the voice channel 30 of the air interface 26 selected by the mobile switching center 16 and the off-hook telephone set 12 to 25 thus establish a voice path connection (comprising in part the selected voice channel 30) between the telephone set 12 and the mobile switching center 16. At or about the same time that the voice path is established, the mobile switching center 16 generates and applies a dial tone to 30 the voice path (step 64) using a tone/message generator unit 40. In response to presentation of the dial tone to

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the caller at the off-hook telephone set 12, the caller may then enter, through the key pad of the off-hook telephone set, the telephone number of party to which the call is being made (step 66). The DTMF tones for the 5 digits of the telephone number entered by the caller are then transmitted over the voice path via the selected voice channel 30 to the mobile switching center 16 (step 70) for detection by a key set code reception unit 42 and further processing.

10 Following the application of the dial tone to the voice path (step 64), the mobile switching center waits in step 72 for the receipt over the voice channel 30 of the DTMF tones corresponding to the digits of the telephone number dialed by the caller. If a time-out 15 expires either before receipt of a first DTMF tone, or between receipt of successive DTMF tones, as determined in decision step 74, the mobile switching center 16 applies a reorder (or congestion or alert) tone or voice message, as appropriate, to the voice path (step 76) for 20 presentation to the called through the telephone set 12. The DTMF dialing tones transmitted from the telephone set 12 over the voice path and received by the mobile switching center 16 are processed in step 78 on a one-by-one basis. This processing operation identifies whether 25 the number being dialed is an improper or unauthorized number (path 80) and, if so, the mobile switching center 16 signals the caller by applying a reorder (or congestion or alert) tone or voice message, as appropriate, to the voice path (step 76) using the tone/message generation 30 unit 40. The mobile switching center 16 further processes (path 84) the transmitted dialing tones to decode the

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dialed telephone number and complete the call to the called party in step 86.

Reference is now made to FIGURE 3 wherein there is shown a ping-pong diagram illustrating the interactive operation of the components of the fixed cellular system 10 in accordance with the method of FIGURE 2. When the telephone set 12 goes off-hook 100 to initiate a call, a hook event 102 is detected by the fixed cellular terminal 24. In response thereto, a feature code 104 is generated by the fixed cellular terminal 24 and transmitted 106 over the control channel 28 of the air interface 26 to the base station 20' of the cellular network 14. The transmitted feature code 104 is relayed 108 by the base station 20' to the mobile switching center 16. Responsive to receipt of the feature code 104, the mobile switching center 16 selects 110 a voice channel 30 of the air interface to carry the call and generates a signal 112, identifying the selected voice channel, for transmission 114 and 116 back to the fixed cellular terminal 24 over the control channel 28 and via the base station 20'. A voice path 118, comprising in part the selected voice channel 30, is thus established between the mobile switching center 16 and the off-hook telephone set 12 through the fixed cellular terminal 24 and base station 20' of the cellular network 14. The mobile switching center 16 then applies a dial tone 120 to the voice path 118 and waits for caller identification of the telephone number for the party to be called. Responsive to the applied dial tone 120, the caller enters the digits 122 of the telephone number using the keypad of the off-hook telephone set 12. This caller action generates DTMF tones corresponding to the entered

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digits 122 of the telephone number, with the generated tones being transmitted over the voice path 118 (including the selected voice channel 30) to the mobile switching center 16 for analysis. At the mobile switching center 5 16, the received tones are processed 124 on a one-by-one basis to identify improper or unauthorized digits or combinations of digits, in response to which the caller is signaled of same by the generation and application of a reorder tone (or voice message) to the voice path 118. 10 The received tones are also processed 124 to decode the dialed telephone number and complete the call to the called party.

There are likely to be times when the selection of the voice channel 30 by the mobile switching center in 15 step 58 and the establishment of the voice path in step 62 of FIGURE 2 are delayed, thus preventing the caller from receiving the mobile switching center dial tone and immediately being able to dial the number after taking the telephone set 12 off-hook. In FIGURE 4, there is shown 20 a flow diagram illustrating an alternative method of operation for the fixed cellular telephone system 10 of the present invention to address this problem by providing an alternate dial tone and allowing immediate caller dialing even though the voice path from the mobile 25 switching center to the telephone set has not yet been established. Rather than have the dial tone be generated by the mobile switching center 16 and applied to the voice path (as in FIGURE 2), the dial tone is instead generated on an interim basis by the line interface unit 34 of the 30 fixed cellular terminal 24 in step 57 and applied to the connection made with the off-hook telephone set 12. The

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caller may then enter, through the key pad of the off-hook telephone set 12, the number of party to which the call is being made (step 66'). The DTMF tones for the digits of the telephone number entered by the caller are detected 5 by the line interface unit 34 of the fixed cellular terminal 24 and the corresponding digits are stored in a memory (step 68). The fixed cellular terminal 24 does not perform any one-by-one digit propriety analysis on the digits of the telephone number entered by the caller.

10 When the signal over the control channel 28 of the air interface 26 from the mobile switching center 16 is received indicative of the selection of the voice channel 30 (steps 58' and 60'), and the voice path is established (step 62'), a dial tone is then applied to the voice path 15 (step 64'). Responsive thereto, DTMF tones corresponding to the previously received and stored digits of the dialed telephone number are generated by the fixed cellular terminal 24 and transmitted over the voice path to the mobile switching center 16. If the voice path is 20 established (step 62') prior to caller completion of the dialing operation (step 66'), the previously stored digits of the partially entered telephone number is immediately transmitted by the fixed cellular terminal 24 (step 70') to the mobile switching center over the voice path, and 25 any subsequently entered digits are transmitted over the voice path (step 70") and checked for time out in accordance with step 74 of FIGURE 2 and processed in accordance with step 78 of FIGURE 2.

Reference is now made to FIGURE 5 wherein there is 30 shown a ping-pong diagram illustrating the interactive operation of the components of the fixed cellular system

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10 in accordance with the method of FIGURE 4. When the telephone set 12 goes off-hook 100 to initiate a call, a hook event 102 is detected by the fixed cellular terminal 24. In response thereto, a feature code 104 is generated  
5 by the fixed cellular terminal 24 and transmitted 106 over the control channel 28 of the air interface 26 to the base station 20' of the cellular network 14. The transmitted feature code 104 is relayed 108 by the base station 20' to the mobile switching center 16. Responsive to receipt  
10 of the feature code 104, the mobile switching center 16 selects 110 a voice channel 30 of the air interface to carry the call. When the voice channel selection process and establishment of the voice path take an unusually long amount of time, and potentially interferes with the  
15 immediate entry of the digits of the telephone number of the party to be called, the fixed cellular terminal 24 operates to apply a dial tone 120' and then receive the DTMF tones for the digits 122 dialed by the caller identifying the party to be called. The tones are  
20 detected by the line interface unit and processed to identify and store the corresponding caller dialed digits. Once the voice channel 30 is selected 110, the mobile switching center 16 generates a signal 112 for transmission 114 and 116 back to the fixed cellular  
25 terminal 24 over the control channel 28 using the base station 20'. A voice path 118, comprising in part the selected voice channel 30, is thus established between the mobile switching center 16 and the off-hook telephone set 12 through the fixed cellular terminal 24 and base station 20'. The mobile switching center 16 then applies a dial tone 120 to the voice path 118 and waits for the reception  
30

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of the DTMF tones identifying the party to be called. Responsive to the applied dial tone 120, DTMF tones corresponding to any previously stored digits for the dialed telephone number are generated 122' by the terminal 5 24 and transmitted over the voice path 118 to the mobile switching center. If the caller has not finished dialing the telephone number (as shown in FIGURE 5), the caller then completes entry of the digits 122 of the telephone 10 number of the party to be called using the keypad of the off-hook telephone set 12, with the generated tones transmitted over the voice path 118 to the mobile switching center 16 for analysis. At the mobile switching center 16, the received tones are processed 124 on a one-by-one basis to identify improper or unauthorized digits 15 or combinations of digits and to decode the telephone number and complete the call.

Although a preferred embodiment of the method and apparatus of the present invention has been illustrated in the accompanying Drawings and described in the 20 foregoing Detailed Description, it will be understood that the invention is not limited to the embodiment disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the spirit of the invention as set forth and defined by the following 25 claims.

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WHAT IS CLAIMED IS:

1. In a fixed cellular system, a method for call set-up comprising the steps of:

detecting an off-hook event for a standard telephone  
5 set;

transmitting a signal indicative of the detected off-hook event over a control channel of a cellular air interface;

10 responsive to cellular telephone system receipt of the off-hook event signal, selecting a voice channel of the cellular air interface to carry the call;

establishing a voice path connection between the cellular telephone system and the telephone set, the voice path comprising in part the selected voice channel;

15 transmitting from the telephone set over the established voice path digit signals indicative of a telephone number of a called party for the call; and

processing of the voice path transmitted digit signals by the cellular telephone system to complete the  
20 call to the called party.

2. The method of claim 1 wherein the off-hook event signal comprises a cellular telephone service feature code requesting selection of a voice channel.

25

3. The method of claim 1 wherein the digit signals comprise DTMF tones.

30 4. The method of claim 1 further comprising the step of applying by the cellular system of a dial tone to

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voice path following selection of the voice channel to carry the call.

5       5. The method of claim 1 wherein the step of processing comprises the step of processing the transmitted digit signals to identify improper or unauthorized digits or combinations of digits in the telephone number.

10      6. The method of claim 1 wherein the step of processing comprises the step of processing the transmitted digit signals to decode the telephone number of the called party and complete the call.

15      7. The method of claim 1 further including the steps of:

testing for a time-out before receipt of a first one of the digit signals or between consecutive ones of the digit signals; and

20      responsive to the time-out, applying a reorder indication to the voice path.

8. A fixed cellular telephone system, comprising:  
a standard telephone set;  
a fixed cellular terminal electrically connected to the telephone set and including:

25      means for detecting an off-hook event for the telephone set at the initiation of a call; and  
means responsive to the detected off-hook event for transmitting an event signal over a control channel of a cellular radio frequency air interface;  
30      and

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a cellular telephone system including means responsive to receipt of the transmitted event signal for selecting a voice channel of the cellular radio frequency air interface to carry the call, the selected voice channel comprising a part of a voice path connection for the call made between the cellular telephone system and the off-hook telephone set via the fixed cellular terminal.

10 9. The fixed cellular system of claim 8 wherein the cellular telephone system further includes means for applying a dial tone to the voice path connection.

15 10. The fixed cellular system of claim 8 wherein a telephone number for the call is entered into the telephone set and transmitted over the voice path connection, and wherein the cellular telephone system further includes means responsive to receipt of the telephone number for completing the call to a called party.

20 11. The fixed cellular system of claim 10 wherein the cellular telephone system further includes means for analyzing the entered telephone number to identify instances of improper or unauthorized digits or combinations of digits in the telephone number.

30 12. The fixed cellular system of claim 8 wherein the event signal comprises a cellular telephone service feature code requesting selection of a voice channel.

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13. A fixed cellular terminal for use in a fixed cellular communications system and for electrical connection to a standard telephone set, comprising:

5 means for detecting an off-hook event concerning the telephone set at the initiation of a call;

means responsive to the detected off-hook event for transmitting an event signal over a control channel of a cellular radio frequency air interface to a cellular telephone system;

10 means responsive to a selection signal received from the cellular telephone system over the control channel for establishing a call voice path connection between the off-hook analog telephone set and the cellular telephone system, the voice path connection comprising in part a voice channel of the cellular radio frequency air interface identified by the received selection signal.

15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995 1000 1005 1010 1015 1020 1025 1030 1035 1040 1045 1050 1055 1060 1065 1070 1075 1080 1085 1090 1095 1100 1105 1110 1115 1120 1125 1130 1135 1140 1145 1150 1155 1160 1165 1170 1175 1180 1185 1190 1195 1200 1205 1210 1215 1220 1225 1230 1235 1240 1245 1250 1255 1260 1265 1270 1275 1280 1285 1290 1295 1300 1305 1310 1315 1320 1325 1330 1335 1340 1345 1350 1355 1360 1365 1370 1375 1380 1385 1390 1395 1400 1405 1410 1415 1420 1425 1430 1435 1440 1445 1450 1455 1460 1465 1470 1475 1480 1485 1490 1495 1500 1505 1510 1515 1520 1525 1530 1535 1540 1545 1550 1555 1560 1565 1570 1575 1580 1585 1590 1595 1600 1605 1610 1615 1620 1625 1630 1635 1640 1645 1650 1655 1660 1665 1670 1675 1680 1685 1690 1695 1700 1705 1710 1715 1720 1725 1730 1735 1740 1745 1750 1755 1760 1765 1770 1775 1780 1785 1790 1795 1800 1805 1810 1815 1820 1825 1830 1835 1840 1845 1850 1855 1860 1865 1870 1875 1880 1885 1890 1895 1900 1905 1910 1915 1920 1925 1930 1935 1940 1945 1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070 2075 2080 2085 2090 2095 2100 2105 2110 2115 2120 2125 2130 2135 2140 2145 2150 2155 2160 2165 2170 2175 2180 2185 2190 2195 2200 2205 2210 2215 2220 2225 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5230 5235 5240 5245 5250 5255 5260 5265 5270 5275 5280 5285 5290 5295 5300 5305 5310 5315 5320 5325 5330 5335 5340 5345 5350 5355 5360 5365 5370 5375 5380 5385 5390 5395 5400 5405 5410 5415 5420 5425 5430 5435 5440 5445 5450 5455 5460 5465 5470 5475 5480 5485 5490 5495 5500 5505 5510 5515 5520 5525 5530 5535 5540 5545 5550 5555 5560 5565 5570 5575 5580 5585 5590 5595 5600 5605 5610 5615 5620 5625 5630 5635 5640 5645 5650 5655 5660 5665 5670 5675 5680 5685 5690 5695 5700 5705 5710 5715 5720 5725 5730 5735 5740 5745 5750 5755 5760 5765 5770 5775 5780 5785 5790 5795 5800 5805 5810 5815 5820 5825 5830 5835 5840 5845 5850 5855 5860 5865 5870 5875 5880 5885 5890 5895 5900 5905 5910 5915 5920 5925 5930 5935 5940 5945 5950 5955 5960 5965 5970 5975 5980 5985 5990 5995 6000 6005 6010 6015 6020 6025 6030 6035 6040 6045 6050 6055 6060 6065 6070 6075 6080 6085 6090 6095 6100 6105 6110 6115 6120 6125 6130 6135 6140 6145 6150 6155 6160 6165 6170 6175 6180 6185 6190 6195 6200 6205 6210 6215 6220 6225 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8230 8235 8240 8245 8250 8255 8260 8265 8270 8275 8280 8285 8290 8295 8300 8305 8310 8315 8320 8325 8330 8335 8340 8345 8350 8355 8360 8365 8370 8375 8380 8385 8390 8395 8400 8405 8410 8415 8420 8425 8430 8435 8440 8445 8450 8455 8460 8465 8470 8475 8480 8485 8490 8495 8500 8505 8510 8515 8520 8525 8530 8535 8540 8545 8550 8555 8560 8565 8570 8575 8580 8585 8590 8595 8600 8605 8610 8615 8620 8625 8630 8635 8640 8645 8650 8655 8660 8665 8670 8675 8680 8685 8690 8695 8700 8705 8710 8715 8720 8725 8730 8735 8740 8745 8750 8755 8760 8765 8770 8775 8780 8785 8790 8795 8800 8805 8810 8815 8820 8825 8830 8835 8840 8845 8850 8855 8860 8865 8870 8875 8880 8885 8890 8895 8900 8905 8910 8915 8920 8925 8930 8935 8940 8945 8950 8955 8960 8965 8970 8975 8980 8985 8990 8995 9000 9005 9010 9015 9020 9025 9030 9035 9040 9045 9050 9055 9060 9065 9070 9075 9080 9085 9090 9095 9100 9105 9110 9115 9120 9125 9130 9135 9140 9145 9150 9155 9160 9165 9170 9175 9180 9185 9190 9195 9200 9205 9210 9215 9220 9225 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16. A method for setting-up a call in a fixed cellular telephone system, comprising the steps of:

transmitting a signal over a control channel of a cellular telephone system radio frequency air interface indicative of a standard telephone set off-hook event;

selecting a voice channel of the cellular telephone system radio frequency air interface to carry the call; and

establishing a voice path connection for the call, the voice path connection extending between the off-hook telephone set and the cellular system and including as a part thereof the selected voice channel of the cellular telephone system radio frequency air interface.

15 17. The method of claim 16 further including the step of applying a dial tone to the voice path connection extending between the off-hook telephone set and the cellular system.

20 18. The method of claim 16 further including the step of transmitting signals indicative of digits in a telephone number for the call over voice path connection extending between the off-hook telephone set and the cellular system.

25 19. The method of claim 18 further including the step of processing the transmitted digit signals to complete connection of the call to the telephone number.

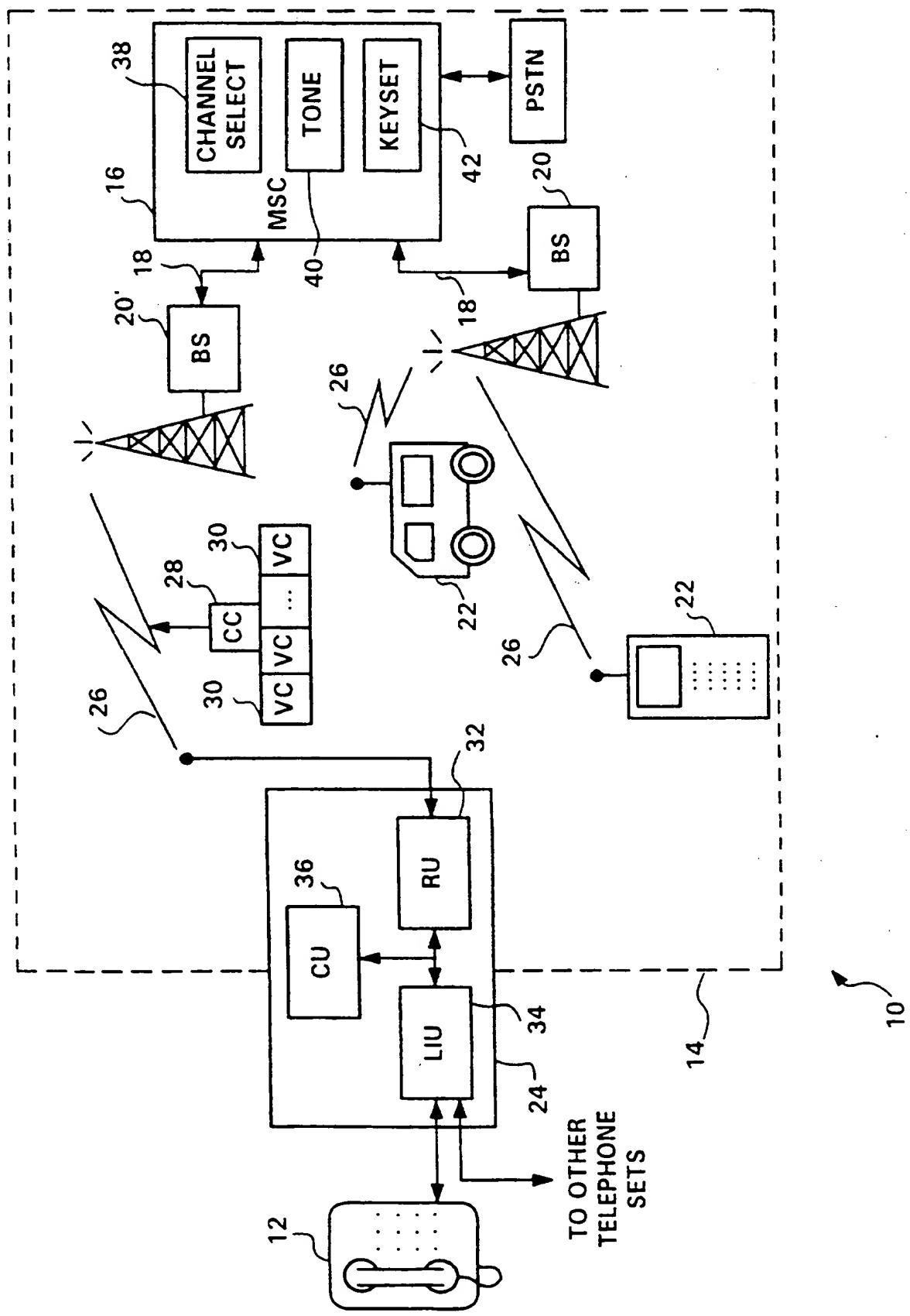
30 20. The method of claim 18 further including the step of processing the transmitted digit signals to

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identify instances of improper or unauthorized digits or combinations of digits in the telephone number.

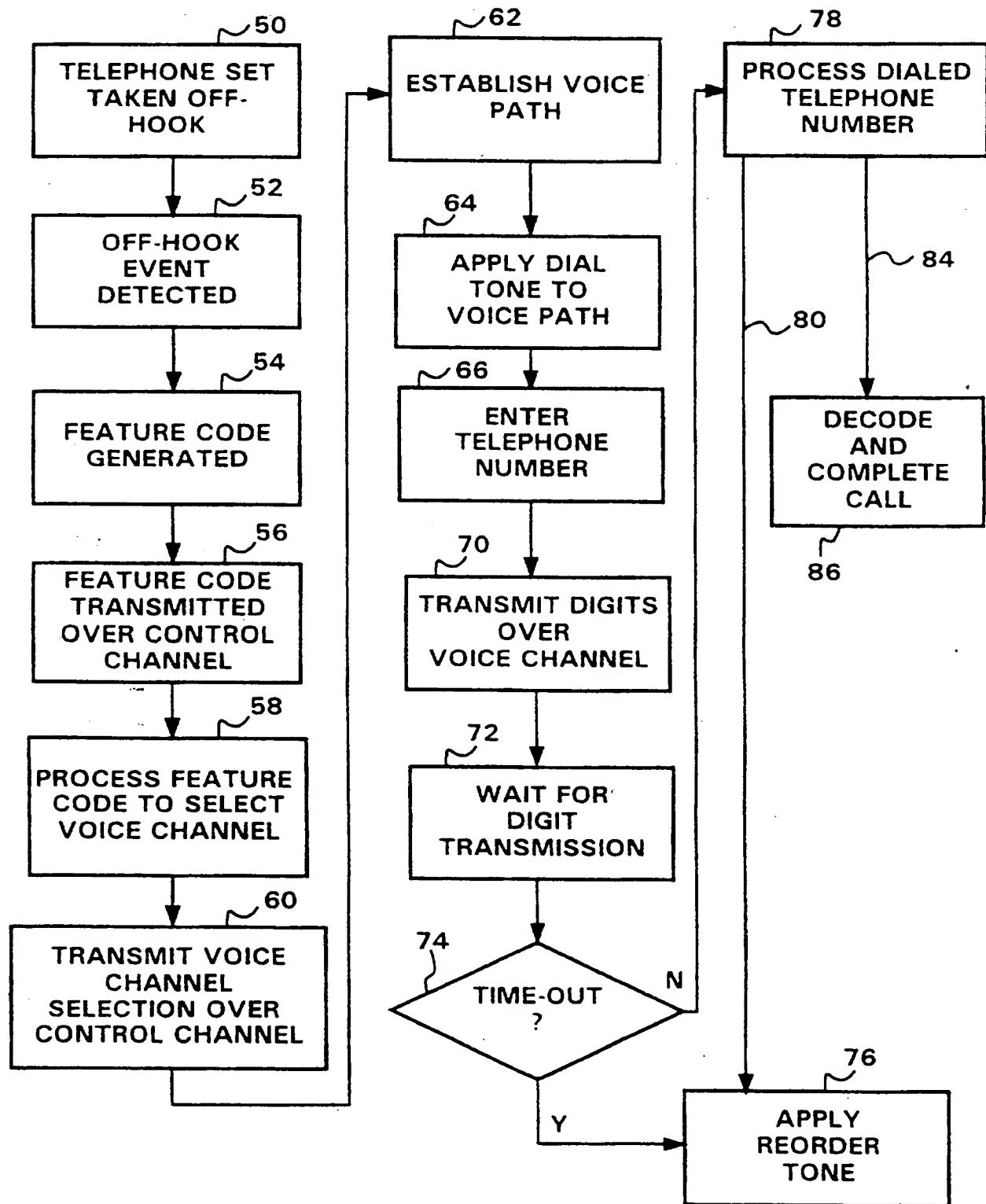
1 / 5

FIG.



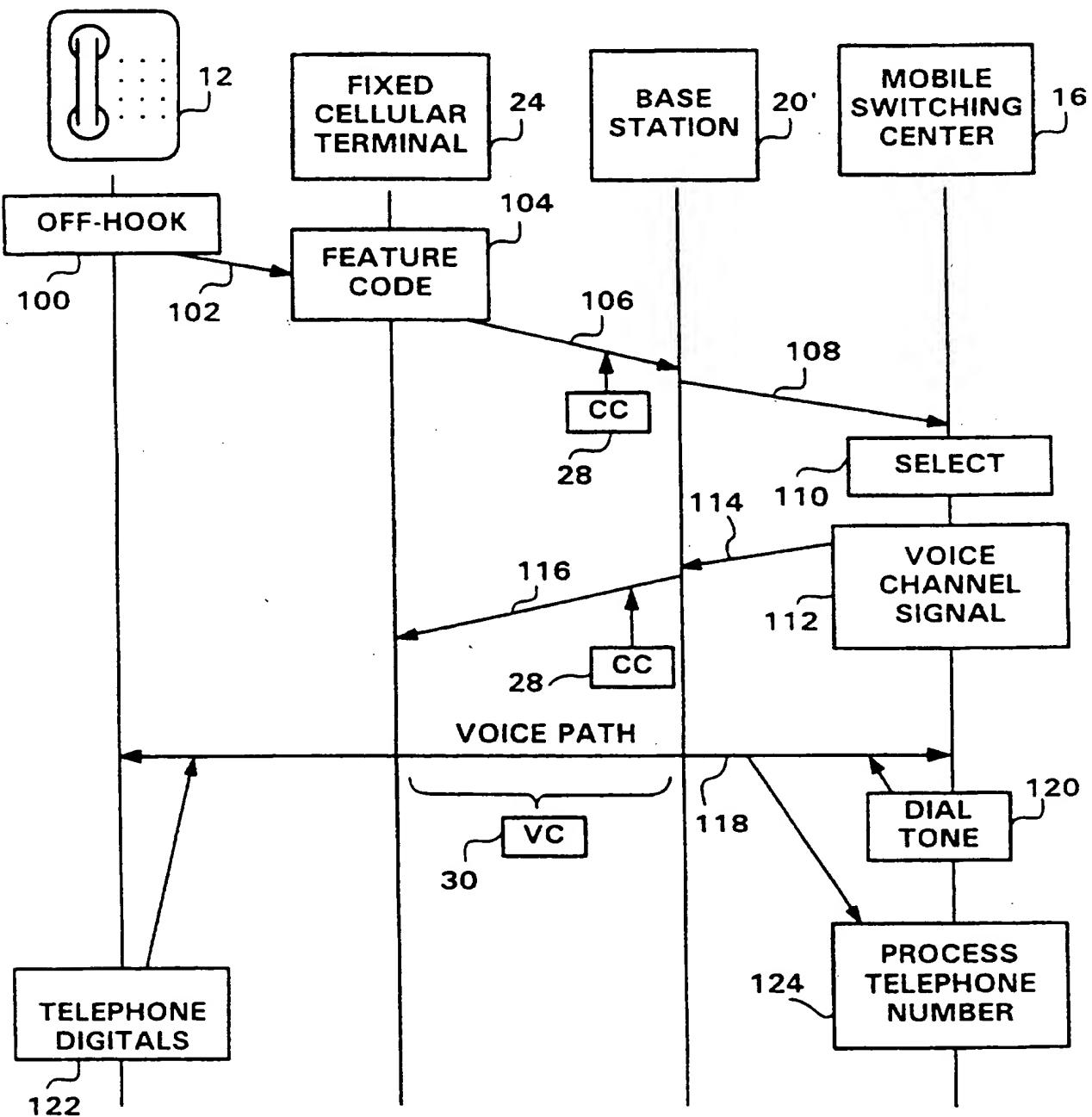
2 / 5

FIG.2



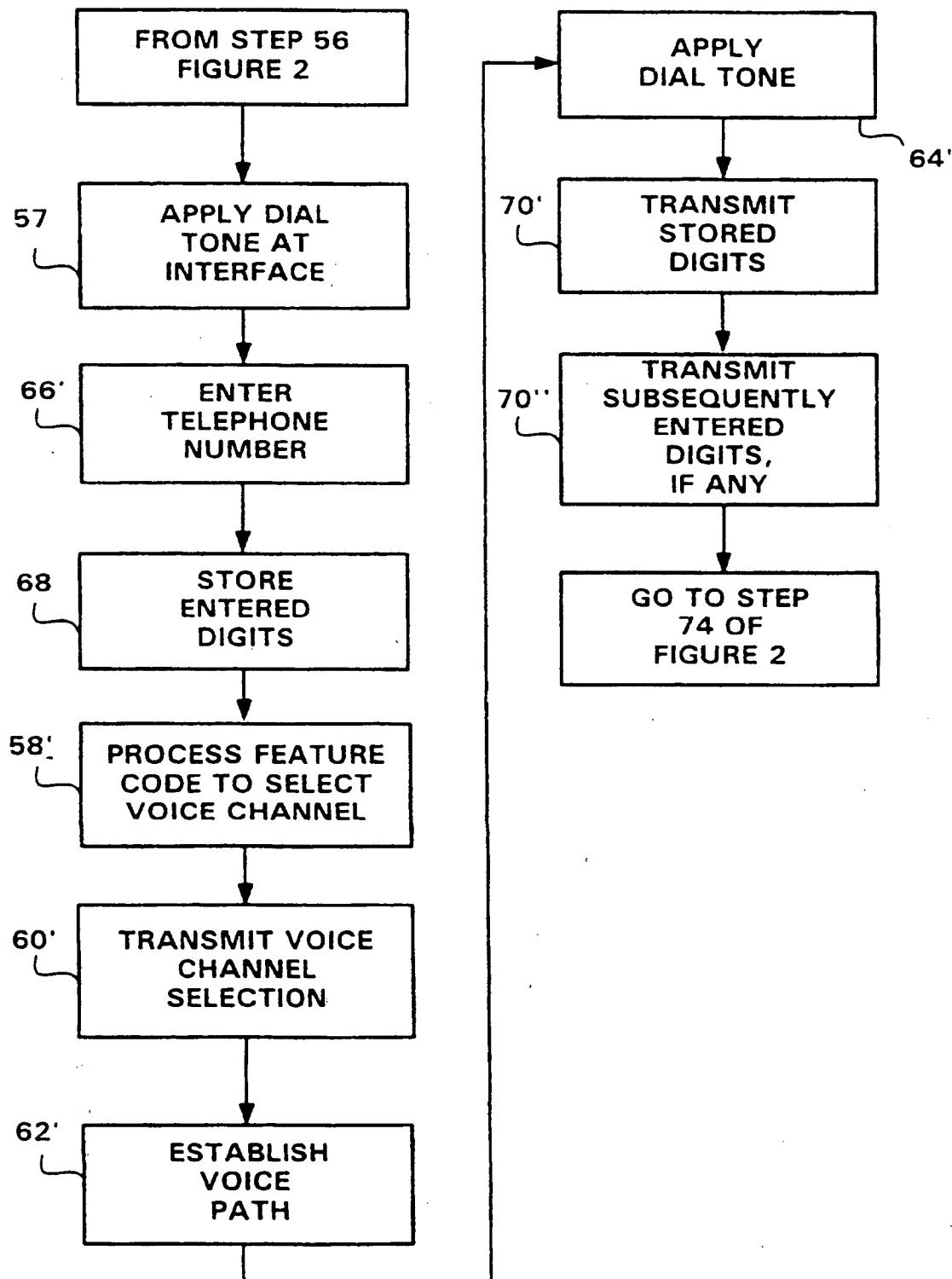
3 / 5

FIG. 3



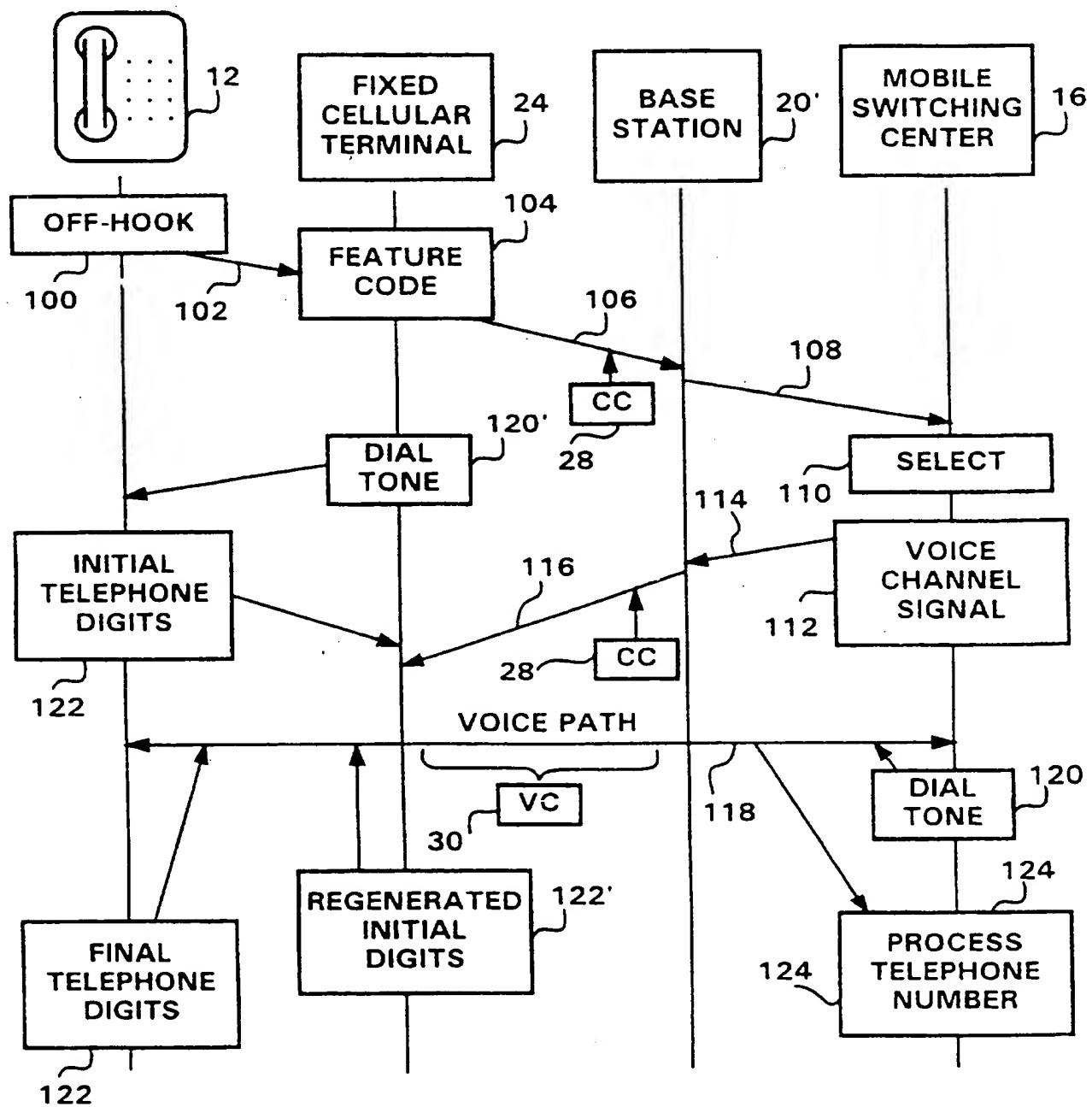
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FIG. 4



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FIG. 5



# INTERNATIONAL SEARCH REPORT

International Application No

PCT/SE 96/01181

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC 6 H04Q7/20

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 95 24103 A (NOKIA TELECOMMUNICATIONS OY) 8 September 1995 see page 5, line 7 - page 7, line 22 ---	1-6, 8-10,12, 13,16-20
X	DE 42 40 249 C (HACHENCERGER ET AL) 5 May 1994 see page 5, line 17 - line 19 see page 6, line 3 - line 34 see page 7, line 33 - line 60 ---	1-4,6, 8-10,12, 13,15-19
X,P	WO 96 13948 A (ALCATEL N.V. ET AL) 9 May 1996 see page 5, line 4 - page 8, line 29 -----	1-4,6, 8-10,12, 13,16-19



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

5 February 1997

Date of mailing of the international search report

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**INTERNATIONAL SEARCH REPORT**

Information on patent family members

Intern: ai Application No

PCT/SE 96/01181

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WO-A-9613948	09-05-96	AU-A-	3428595	09-05-96
		AU-A-	4379096	23-05-96
		ZA-A-	9509213	27-05-96

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